

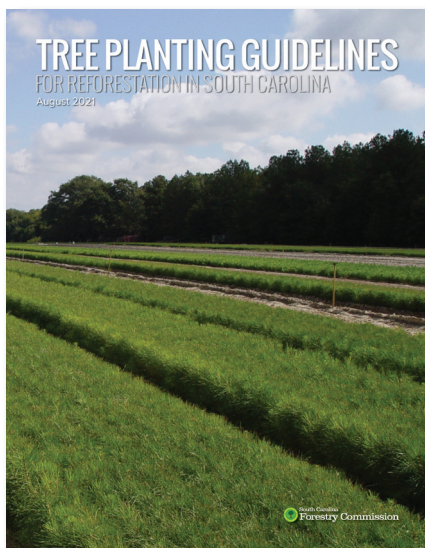
TREE PLANTING GUIDELINES

FOR REFORESTATION IN SOUTH CAROLINA





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Tree Planting Guidelines for Reforestation in South Carolina

Prepared by

Carla Castro

Tree Improvement Specialist
South Carolina Forestry Commission
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FOREWORD

Planting large volumes of seedlings must be conducted according to exacting specifications and with great care to ensure optimal productivity and quality at the end of the rotation cycle. This guide, which provides all the information landowners need to establish a successful, flourishing stand of trees, focuses on four key topics:

1. Proper care of seedlings before planting
2. Proper pruning of roots, if necessary
3. Proper spacing
4. Proper planting techniques:

It is also of the utmost importance that seedlings are planted properly to achieve cost-share compliance. For example:

- A minimum of 80% of the trees on an area shall be planted with no planting errors (J-, L- or U-rooting; multiple seedlings per hole; improper root pruning, etc.)
- The number of trees planted per acre must also be within +50 of the range called for in the planting plan. While spacing recommendations are tailored to meet the landowner's management objectives, there must be 300 well-spaced seedlings at the end of the first growing season. Example: Tree planting prescription calls for spacing of 8'x 10' (requiring 544 trees per acre). The trees planted per acre must fall between 494 and 594 to qualify for cost-share compliance.



SCFC Tree Improvement Specialist Carla Castro measures a tree in a Flexstand demonstration planting at Niederhof Forestry Center. After nine growing seasons, these trees average 7" dbh.

HANDLING OF LOBLOLLY PINE SEEDLINGS

It is extremely important that seedlings receive proper care from the time they leave the nursery to the time they are planted in the field. The following guidelines will help ensure against the loss of vigor, or even death, of seedlings before they are planted.

Acceptance at the nursery

1. Pick up seedlings as close to planting time as possible. Whenever possible, schedule your planting during the dormant season, when trees are not actively growing (December to mid-February).
2. Pick up seedlings when weather is cool and humidity is high (>50%); travel in the early morning or early evening.
3. Do not open bags until you are at the planting site.
4. If you must check, open one bag and look for the following signs of poor quality:
 - a. Dry roots
 - b. White root tips (elongation has begun)
 - c. Swollen or burst buds
 - d. Presence of mold on needles or stems
 - e. Sour smell – fermentation
 - f. Bark slips off easily, especially on roots
5. Check for ripped bags or crushed boxes, exposing seedlings to circulating air.

Transportation from the nursery to local storage

1. Cover seedlings during transport to shade and protect them.
2. Use racks, spacers, or loading pallets for good air circulation. Make sure at least one side of every box or bag is exposed to circulating air. Do not stack bareroot longleaf pine.
3. Do not park vehicles in direct sunlight.
4. Allow air space between all interior surfaces of the cargo space and the bags or boxes.
5. Secure seedling bags or boxes in cargo space to prevent shifting when traveling on rough roads. Handle carefully at all times. Physical abuse causes respiratory heat and a subsequent decline in seedling vigor.

Local storage

1. Unload the vehicle quickly and carefully.
2. Plant the seedlings as soon as possible. Keep temporary storage time to a minimum.
3. Use a cooler if available.
 - a. Keep the cooler temperatures between 35°F and 38°F and provide continuous monitoring.
 - b. Use facilities with devices that warn of high and low temperatures if possible.
 - c. Make sure seedlings are moist and bags or boxes are well sealed before storage, especially if humidifiers are not available.
 - d. Store bags or boxes on pallets so each container has at least one surface exposed to circulating air.
4. If a cooler is not available:
 - a. Place bags or boxes on the north (shaded) side of a large structure or under the canopy of a very dense grove of evergreen trees (no ground vegetation).
 - b. Cover bags or boxes with a reflective tarp set up as a lean-to. Such a tarp will protect against radiation, provide shade, and allow air to circulate.
 - c. Check bags or boxes for rodent damage frequently and repair rips or tears immediately. Check seedlings to make sure they are still moist and seal bags or boxes tightly.
 - d. Smell inside bags especially those a few days old to see if seedlings have spoiled. The odor will resemble distilled sour mash.



Transportation to the planting site

1. Make sure the site is ready to be planted.
2. Take only as many seedlings to the field as can be planted that day.
3. Handle bags gently and take precautions to minimize bouncing and sliding around in the bed of the truck.
4. If the weather is sunny, windy, dry, or warm, be sure to have something to keep seedlings protected (i.e. water, reflective tarp, damp mulch).
5. Keep seedlings away from fuel and chemicals.

Seedling protection at the planting site

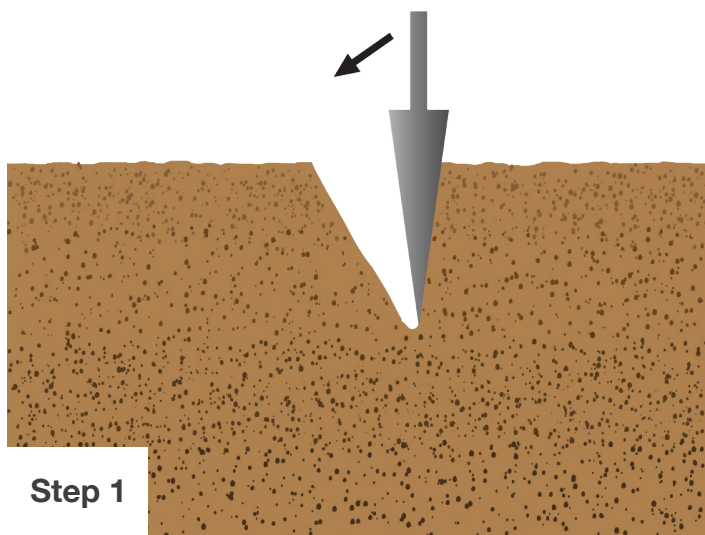
1. Never allow planters to sit on bags or boxes.
2. Never place anything heavy on bags or boxes. For example, never use spare tires to keep the protective tarp secure while transporting seedlings from site to site.
3. Park in the shade. Seedlings must be in a shaded location at all times.
4. If a pickup with a protective tarp is used and no shade is available, remove the bags or boxes of seedlings from the bed, place them in the shade of the pickup, and cover them with a protective tarp.
5. Keep seedling containers tightly sealed and in the refrigerated van or under the insulated pickup canopy until the planter returns for another load.
6. Open one seedling bag/box at a time; tightly close the partially filled bag/box to prevent moisture loss. Repair torn bags with duct tape immediately.
7. Carefully separate roots in seedling bundles to minimize root damage.

Hand-planting

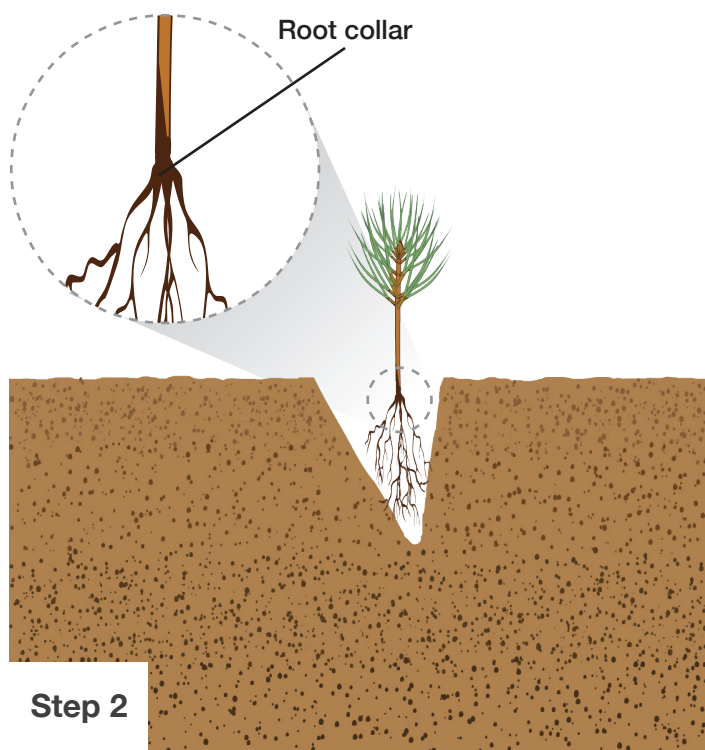
1. Assign inspectors (1 per 5 planters) to planting crews and check for consistency among inspectors.
2. Seedlings must be placed in planting bags so roots are well protected from dry, circulating air.
3. Do not pack seedlings too tightly in seedling pouches; keep them loose for easy removal and minimal damage to young stems and small roots.
4. Keep seedling roots moist (wet mulch), use insulated bags, and only provide planters with enough seedlings to plant for 1 hour on warm, windy, dry days or for 2 hours on cool, calm, humid days. Use one person to distribute seedlings to planters.
5. Use insulated bags that are designed for tree planting.
6. Use a planting tool that is best suited to the seedling roots and the site.
7. Do not allow planters to field-prune roots. If root pruning is required, appoint one well-trained and supervised person to do the pruning. (See root pruning guidelines)
8. Do not allow planters to hit or vigorously shake seedlings in an effort to dislodge excess soil.
9. Seedlings should be pulled gently from planting bags to avoid stripping the roots.
10. Remove trees from the planting bag one at a time and only after the hole is prepared.
11. Set the seedling gently in the bottom of the hole, and then pull the seedling back up so that the root collar is 1-2 inches below the surface. Roots should fall straight down in the planting hole. Do not allow J-, L- or U-rooting (please see specifications for planting depth of longleaf pine seedlings on page 10).
12. Make sure soil is gently, but firmly packed around the root system as the hole is filled.
13. All seedlings in a planting bag should be planted before taking a break.



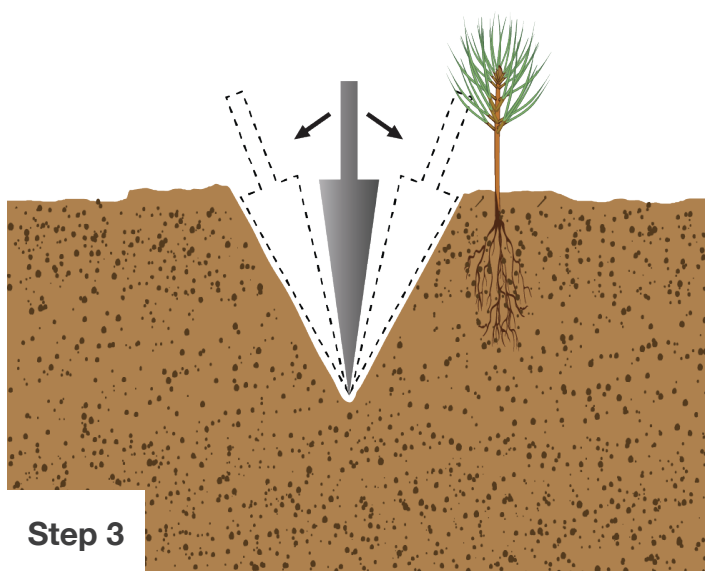
HOW TO PLANT WITH A DIBBLE



Push blade vertically into the soil; pull the handle toward you to open a hole.



Do not twist or cram seedlings into planting hole. Set seedling gently to bottom of planting hole; then pull on the stem so that the root collar is 1-2 inches below soil surface, making sure roots are straight.

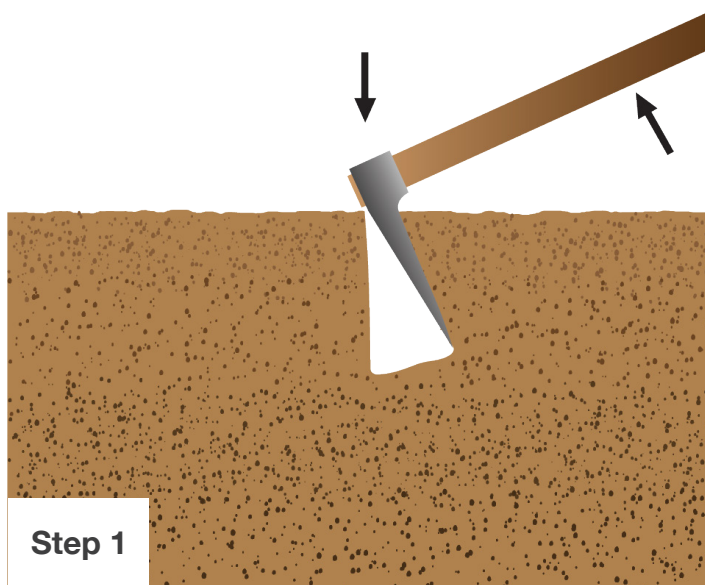


Push blade into soil just behind the planting hole; pull handle back to close bottom of hole, push forward to close the top.

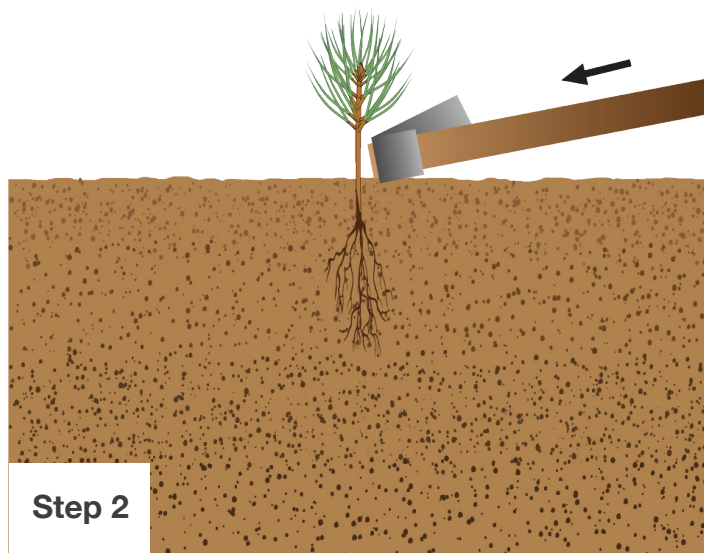


Pack soil firmly with your heel.

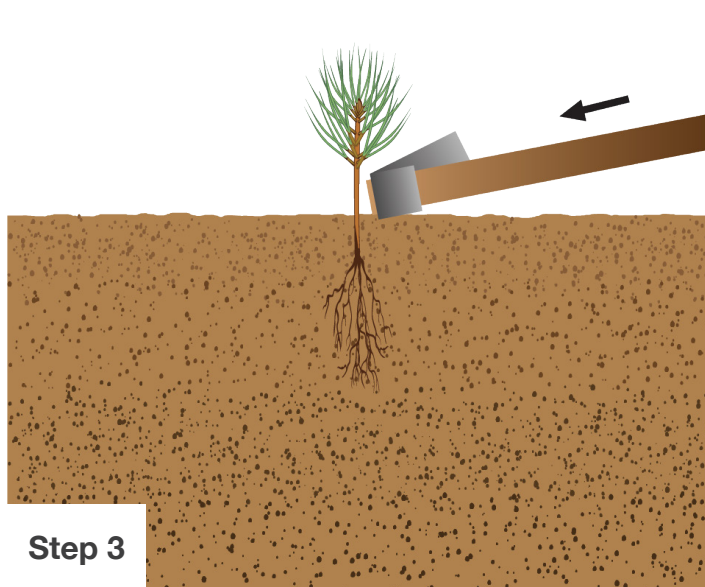
HOW TO PLANT WITH A HOEDAD



Drive blade into the soil; lift handle to open bottom of the hole.



Pull the handle toward you, opening the top of the hole. Set seedling vertically, deeper than nursery depth. Do not twist or cram seedlings into planting hole. Set seedling gently to bottom of planting hole; then pull on the stem so that the root collar is 1-2 inches below soil surface, making sure roots are straight.



Push soil into hole with back of the blade.



Pack soil firmly with your heel.

MACHINE PLANTING OF LOBLOLLY PINE SEEDLINGS

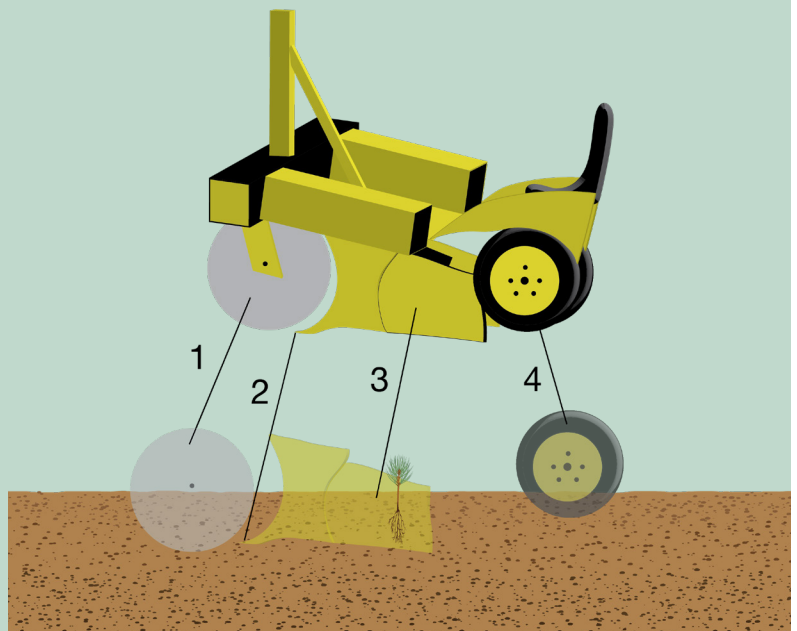
After the planting machine has been tested and adjusted to the site's soil type – this is critical, as each planting site is different – the tree planter and tractor driver should plant a row to check for proper depth and packing of the seedlings. Instructions should be repeated for each new operator. The following points should be made:



1. Seedlings must not be allowed to freeze (below 32 degrees) or be left in temperatures above 50 degrees for more than a few hours. Seedlings must be kept cool and roots must be kept moist at all times.
2. Seedlings should be placed at the proper depth in the furrow and held until the hand reaches the packing wheels. It is good for the tree setter to gently shake the seedling roots after the seedling is lowered in the trench back of the plow to distribute the root system in a natural manner. The setter should know the depth to plant the seedling regardless of its size. The act of placing the seedlings in the trench must become an automatic operation since the setter does not have time to look at each seedling and decide its depth. The tractor operator must also determine the best tractor speed by allowing the tree setter to signal the operator for any needed changes in speed. Having the proper depth of furrow when planting large stock is especially important to ensure that the taproot has enough space to avoid bending.
3. The tractor and driver are important parts of tree planting. An alert tractor driver can contribute to a good overall planting job. He is responsible for the straightness of the rows, proper spacing between rows, and speed of the tractor. Tractor speed is an important element in hourly or daily production. A new planting crew should start at a slow rate of speed and increase their speed, as they become more proficient. The setter should acquire a rhythm after some practice so that an average of about 1,000 seedlings are planted per hour. At this speed, about three seconds are allowed to plant each seedling.

Machine planting pine seedlings

1. Coulter should cut at least 9" deep. Hub should not drag in the soil.
2. Plow point should run slightly above bottom of coulter furrow.
3. Set seedling in trench 1-2" deeper than nursery depth (loblolly). Roots should be straight and seedling should be vertical. Planting depth specifications for longleaf pine are on page 9.
4. Packing wheels should pack soil tightly around roots, but should not depress soil more than 1 ½ inches.



KEYS TO SUCCESSFULLY PLANTING LONGLEAF PINE SEEDLINGS

Due to high demand, you should order longleaf seedlings as soon as they are available, usually beginning in July. Contact either your forester or ArborGen Taylor Nursery to place your order by filling out a seedling order form or calling the nursery directly at (803) 275-3578.

The Longleaf Alliance also maintains a list of nurseries that provide longleaf seedlings. Contact the Longleaf Alliance at (334) 427-1029 or www.longleafalliance.org.

Containerized or bareroot seedlings – Containerized longleaf seedlings usually have a much better average survival rate than bareroot longleaf seedlings. To increase the chances of survival of bareroot seedlings, machine planting is recommended.

Storage of longleaf seedlings – Bareroot longleaf seedlings should be planted within 2 days of lifting from the nursery. Containerized seedlings will store better (if kept at 34 degrees F), but still should be planted soon after removal from their trays.



Scalping is highly recommended in agricultural fields and pastures. Even those fields that do not have significant components of perennial grasses may benefit because of the seed bank of late germinant grasses and broadleaf seeds present in the soil.

Planting depth

Containerized – the top of the plug should be visible above the ground. On dry sites that will not be scalped leave ¼ to 1” of the plug exposed (visible above ground). On wet sites (potential for flooding and ponding) that will not be scalped leave 1 ½ to 3” of the plug exposed. On sites that have been scalped leave 1 to 1 ½” of the plug exposed. Use the correct tool when hand-planting. Many containerized seedlings have tools designed especially for certain plug sizes.

Bareroot – plant with bud ½” under soil surface. If machine planting, the coulter should be 32-34” in diameter at a minimum and the foot of the planter should go into the soil deep enough to get at least a 10-inch planting depth. Good compaction is needed to eliminate air pockets around seedling roots. A good bareroot will have at least an 8-inch root system from root collar to the tip of the taproot with numerous well developed lateral roots. The root collar should be the size of a little finger (¼ inch or greater); any seedlings smaller than this should be culled out.

Herbicide site-prep and time of planting

Longleaf is more sensitive to herbicides than loblolly, and to minimize this sensitivity, it is recommended to herbicide site-prep earlier in the growing season (July) and plant no sooner than late December. Waiting 4.5 to 5.5 months between spraying and planting is a good “rule-of-thumb.” For herbicide rates and application dates and the recommended planting intervals, please refer to “SCFC’s SPB Program’s Guide to Herbicide Site-Prep...” available at www.state.sc.us/forest/spb913.pdf

Weather and soil conditions

Plant during nonfreezing temperatures when soils have ample moisture. Freezing temperatures and frozen or dry soils should be avoided.

Planting longleaf on sites with established grasses

1. Broadcast sprays of herbicides are recommended according to label the summer prior to planting.
2. Scalp rows 2-3’ wide on the planting site at least a month before planting.
3. Apply herbicides (if needed) as pre-emergent/early emergent treatments for herbaceous weed control.

Planting longleaf on sites where a hardpan exists

1. Subsoil or ‘rip’ the hardpan to a depth of 16-18” several months before planting. Subsoiling increases water infiltration within the rootzone and better root development, which leads to better seedling survival and increased growth and stability.
2. Plant 4-6” to the side of the rip; this minimizes seedlings being buried within the rip and subsequent mortality.

PINE TREE PLANTING NUMBERS TO KNOW

1. Remove seedlings from the planting bag one at a time when hand planting.
2. Insert dibble blade 2 times for each seedling planted.
3. Dibble blade: 8-10 inches long.
4. Best planting day (Weather conditions): Temperature, maximum: 33F to 75F, Relative Humidity: 50%+, Windspeed, maximum: 10 mph, Soil moisture: top 3" of soil is moist.
Use extreme care if: temperature >75°F, relative humidity <25%, wind >15mph, soil moisture: top 3" of soil is dry.
*DO NOT PLANT if the soil is frozen or if the weather forecast calls for temperatures that will cause the ground to freeze for several days immediately after planting.
5. Inside bag temperatures: 34° to 60°F
6. Stem thickness at the ground line (root collar): Loblolly: greater than 1/8 inch Longleaf: -bareroot: greater than 2/5 inch -containerized: greater than 1/4 inch
7. Stem length (top): Loblolly: 8 to 14 inches/ Longleaf: 6 to 10 inches needle length.
8. Root length: 5 to 8 inches.
*DO NOT root prune unless absolutely necessary (roots are longer than dibble blade). Small seedlings (5 to 8 inch tops) should be root pruned no shorter than 7 inches. DO NOT prune longleaf seedling roots – lateral roots can be air pruned if necessary.
9. The number of trees planted per acre depends on the final product desired.
10. Seedlings should be planted straight up, leaning no more than 20 degrees from perpendicular to the ground surface.

Root pruning guidelines

Seedling roots are normally pruned in the nursery bed and do not need to be pruned again when planted. However, if pruning is necessary for proper planting, follow these guidelines:

1. Longleaf pine seedlings are not to be root-pruned.
2. Do not cut the taproot shorter than 5 inches.
3. If exceedingly long laterals are present, they may be pruned by pulling them down alongside the taproot and cutting even with the end of the taproot.
4. Protect seedlings from the elements (wind and low humidity) during root pruning. Caution must be taken during this operation to prevent roots from drying out. Keep roots moist.
5. Cut roots with a sharp knife or machete; do not break or twist off by hand.
6. Pruning should be done by one person on the crew to ensure consistency and quality of pruning. There must be an adequate root system to support the seedling.



Handling treated seedlings

Some seedlings are treated upon request of the landowner for protection from Pales weevil.

Safety precautions

1. Wear rubber gloves when planting or handling treated seedlings.
2. Do not rub your eyes when handling treated seedlings.
3. Wash hands with soap and water after handling treated seedlings. Have wash water and soap at the planting site and other areas where treated seedlings will be handled.
4. Wash hands prior to eating lunch or breaktime. The pesticides used to treat seedlings are not highly toxic to humans; however, the above precautions need to be followed at all times to minimize ill effects from contact with these seedlings.

TIPS FOR HARDWOOD TREE PLANTING

Hardwood seedling handling and planting specifications for...

Hand planting

- Seedlings should be planted using a dibble or KBC bar, round-point shovel or auger in a hole wide enough to accommodate the root system in mineral soil.
- Do not remove seedlings from the planting bag until after the planting hole is opened and then no more than one seedling at a time should be removed to help prevent roots from drying.
- The root collar shall be planted at the ground line 1-2 inches below the surface of the soil.
- The shoot and root should be planted vertically aligned. The lateral roots should be spread in a natural manner in the center of the planting hole.
- The planting hole will be closed with the planting tool and the soil firmly packed around the seedling's roots to eliminate air pockets.
- Do not plant seedlings when the surface of the soil is frozen.
- Seedlings should not be root-pruned unless approved.

Machine planting

- Adjust planting foot to run at a minimum depth of 10 inches. Do not plant with the foot raised to reduce drag or avoid bogging. If the ground is too wet to run foot at 10", wait for a drier time. If planting foot is worn to the point of being too short, replace the foot.
- Set the seedling gently in the bottom of the hole, and then pull the seedling back up so that the root collar is 1-2 inches below the surface. Roots should fall straight down in the planting hole.
- The shoot and root will be planted vertically aligned, with no lateral roots exposed.
- Adjust packing wheels to completely close the planting trench from top to bottom. Adjustments may be needed as soil type and moisture change.
- Use tractors and planting machines of sufficient size and weight to ensure proper planting and packing is done. When planting in heavy soils a light tree planter will not be sufficient.
- Take care to avoid damaging seedlings by improper handling or improperly aligned packing wheels.
- Seedlings must be kept in seedling trays on planting machines, or in their original container, so the roots are well protected from dry, circulating air(wind). The roots of seedlings must be kept moist.
- All seedlings should be planted within two hours of the time they were placed on the planter.

Hardwood tree planting prescription

1. Subsoil the planting area the fall before planting (ag fields or pasture only). Allow time for the subsoiled area to settle before planting. Plant seedlings 4-6" from the subsoil trench.
2. Plant during the winter while seedlings are dormant.
3. Apply preemergent herbicide before bud break if needed.
4. Apply herbaceous weed control during the growing season if needed.



HARDWOOD TREE PLANTING NUMBERS

Hardwood seedling specifications

- 6 mm or 1/4-inch minimum root collar diameter for white oak, willow/water oak, water tupelo, baldcypress, and overcup oak.
- 7 mm or 3/8-inch minimum root collar diameter for swamp chestnut oak, cherrybark oak, green ash, sycamore, sweetgum, yellow-poplar, and black walnut.
- 24-inch minimum shoot height.
- Five or more first-order lateral roots are present below the ground line. 8-inch minimum length for roots.
- 3/8 inch minimum top diameter and 16-inch minimum length for cottonwood cuttings.
- Seedlings not forked at the ground line.
- Seedlings with no signs of disease or damage.
- Seedling root collar will be planted between the ground line and 2 inches below.
- The shoot and root will be planted vertically aligned, not to exceed 20 degrees angle.

Recommended hardwood spacing

Spacing	Trees per acre (tpa)
9'x10'	484
10'x10'	435
10'x12'	363

*COST-SHARE COMPLIANCE

It bears repeating that seedlings are planted properly to achieve cost-share compliance.

For example:

- A minimum of 80% of the trees on an area shall be planted with no planting errors (J-, L- or U-rooting; multiple seedlings per hole; improper root pruning, etc.)
- The number of trees planted per acre must also be within +50 of the range called for in the planting plan. While spacing recommendations are tailored to meet the landowner's management objectives, there must be 300 well-spaced seedlings at the end of the first growing season.

Example: Tree planting prescription calls for spacing of 8'x 10' (requiring 544 trees per acre). The trees planted per acre must fall between 494 and 594 to qualify for cost-share assistance.

